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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/042,936	01/09/2002	Lars Langemyr	CMM-00202	4595

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EXAMINER	
SHARON, AYALI	
ART UNIT	PAPER NUMBER
2123	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	01/18/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/042,936	LANGEMYR ET AL.	
	Examiner	Art Unit	
	Ayal I. Sharon	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 November 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-117* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-117* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 April 2002* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *2/10/06*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Introduction

1. Claims 1-117 of U.S. Application 10/042,936 filed on 01/09/2002 are currently pending.
2. The Application is a CIP of U.S. Application 09/995,222, filed on 11/27/2001, which claims benefit to U.S. Application 60/253,154. The Application is also a CIP of U.S. Application 09/675,778, filed on 9/29/2000, which claims benefit to U.S. Application 60/222,394.

Continued Examination Under 37 CFR 1.114

3. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/03/2006 has been entered.

Claim Rejections - 35 USC § 101

4. 35 U.S.C. 101 reads as follows:

> Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

5. **Claims 1-117 are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. The claims lack a "concrete, useful, tangible" result.**

6. The claims are directed to methods and apparatuses for determining at least one of a stiffness matrix and a residual vector for one or more systems. This claimed subject matter lacks a practical application of a judicial exception (law of nature, abstract idea, naturally occurring article/phenomenon) since it fails to produce a useful, concrete and tangible result as required in State Street Bank & Trust Co. v. Signature Financial Group Inc., 149 F. 3d 1368, 1373-74 (Fed. Cir. 1998) and AT&T Corp. v. Excel Communications, Inc., 172 F.3d 1352, 50 USPQ2d 1447 (Fed. Cir. 1999).

7. The claimed invention as a whole must be useful and accomplish a practical application. That is, it must produce a "useful, concrete and tangible result." State Street, 149 F.3d at 1373-74. The purpose of this requirement is to limit patent protection to inventions that possess a certain level of "real world" value, as opposed to subject matter that represents nothing more than an idea or concept, or is simply a starting point for future investigation or research (Brenner v. Manson, 383 U.S. 519, 528-36 (1966)); In re Fisher, 421 F.3d 1365 (Fed. Cir. 2005); In re Ziegler, 992 F.2d 1197, 1200-03 (Fed. Cir. 1993)).

8. The test for practical application as applied by the examiner involves the determination of the following factors:

a. "**Useful**" – According to MPEP § 2106 (IV)(C)(2)(2)(a), the USPTO's official interpretation of the utility requirement provides that the utility of an invention has to be (i) specific, (ii) substantial and (iii) credible. MPEP § 2107 and In re Fisher, 421 F.3d at 1372 (citing the Utility Guidelines with approval for interpretation of "specific" and "substantial"). In addition, when the examiner has reason to believe that the claim is not for a practical application that produces a useful result, the claim should be rejected, thus requiring the applicant to distinguish the claim from the three 35 U.S.C. 101 judicial exceptions to patentable subject matter by specifically reciting in the claim the practical application.

b. "**Tangible**" - Applying In re Warmerdam, 33 F.3d 1354 (Fed. Cir. 1994), the examiner will determine whether there is simply a mathematical construct claimed, such as a disembodied data structure and method of making it. If so, the claim involves no more than a manipulation of an abstract idea and therefore, is nonstatutory under 35 U.S.C. § 101. In addition, According to MPEP § 2106 (IV)(C)(3), a claim that recites a computer that solely calculates a mathematical formula. or a computer disk that solely stores a mathematical formula, is not directed to the type of subject matter eligible for patent protection. Gottschalk v. Benson, 409 U.S. 63 (1972).

c. "**Concrete**" - According to MPEP § 2106 (IV)(C)(2)(2)(a), a claimed process must have a result that can be substantially repeatable, or the

process must substantially produce the same result again. In re Swartz, 232 F.3d 862, 864 (Fed. Cir. 2000) (finding that an asserted result produced by the claimed invention is "irreproducible" claim should be rejected under section 101). The opposite of "concrete" is unrepeatable or unpredictable. An appropriate rejection under 35 U.S.C. § 101 should be accompanied by a lack of enablement rejection, because the invention cannot operate as intended without undue experimentation.

9. An example of a concrete, useful, tangible result is provided in State Street, 149 F.3d at 1373-74, 47 USPQ2d at 1601-02. ("[T]he transformation of data, representing discrete dollar amounts, by a machine through a series of mathematical calculations into a final share price, constitutes a practical application of a mathematical algorithm, formula, or calculation, because it produces 'a useful, concrete and tangible result' – a final share price momentarily fixed for recording and reporting purposes and even accepted and relied upon by regulatory authorities and in subsequent trades").

10. Another example of a concrete, useful, tangible result is provided in AT&T, 172 F.3d at 1358, 50 USPQ2d at 1452 (Claims drawn to a long-distance telephone billing process containing mathematical algorithms were held patentable subject matter because the process used the algorithm to produce a useful, concrete, tangible result - a primary inter-exchange carrier ("PIC") indicator - without preempting other uses of the mathematical principle).

11. The claimed subject matter does not produce a useful or tangible result.

a. A **"Useful"** result is missing because the claimed subject matter fails to sufficiently reflect at least one practical utility set forth in the descriptive portion of the specification. More specifically, the described utility is NOT specific: "represent[ing] various physical aspects of the system in terms of equations or other type of quantifications. In turn, these equations may be solved using a computer system for one or more variables" (See specification, p.2, lines 4-7). The claimed subject matter relates to determining at least one of a "stiffness matrix" and a "residual matrix", neither of which are specific practical utilities.

b. A **"Tangible"** result is missing because the claimed subject matter fails to produce a result that is limited to having real world value rather than a result that may be interpreted to be abstract, for example, a thought, a computation, or manipulated data. More specifically, the claimed methods provides for determining at least one of a "stiffness matrix" and a "residual matrix". This produced result remains in the abstract and, thus, fails to achieve the required status of having real world value. Moreover, the claims that recites a computer that solely calculates the mathematical formula. or a computer disk that solely stores a mathematical formula, are not directed to the type of subject matter eligible for patent protection.

12. Figures 52 and 53 are flowcharts of the claimed embodiments for computing the stiffness matrix, and the residual matrix, respectively. These figures, as well as Figures 54-57, and the associated text for all of these figures in the specification,

are directed to purely mathematical algorithms. See, for example, the embodiment for "assembling the stiffness matrix of a weak equation" (see specification, p.107, lines 4-19). No specific substantial practical application is recited in specification, or in the claims.

13. **Claims 1-117 are also rejected under 35 U.S.C. 101 because the claimed invention preempts a 35 U.S.C. 101 judicial exception. The claims preempt every "substantial practical application" of an idea – a mathematical algorithm.**

14. One may not patent every "substantial practical application" of an idea, law of nature or natural phenomena because such a patent "in practical effect be a patent on the [idea, law of nature or natural phenomena] itself." Gottschalk v. Benson, 409 U.S. 63, 71-72, 175 USPQ 673, 676 (1972).

15. According to MPEP § 2106 (IV)(C)(3), a claim that recites a computer that solely calculates a mathematical formula (see Benson) or a computer disk that solely stores a mathematical formula is not directed to the type of subject matter eligible for patent protection.

16. All of the claims in the instant application share this defect. In particular, none of the independent claims are restricted to any field of application, and therefore the claims are directed to all possible applications of the math recited in the claims.

17. The relevant prior art and contemporaneous art recites a variety of unrelated practical applications for the claimed mathematical results of a stiffness matrix or a residual matrix.

18. The article by J. Saitz, "Newton-Raphson Method and Fixed-Point Technique in Finite Element Computation of Magnetic Field Problems in Media with Hysteresis" (see p.1399, left column, Equations 3-5 and 7, and associated text), teaches determining a finite element stiffness matrix "S", a residual vector "V", and a Jacobian matrix "M", for the purpose of modeling electromagnetic hysteresis.

19. The article by P. Ribeiro, "Non-linear Forced Vibrations of Thin/Thick Beams and Plates by the Finite Element and Shooting Methods" teaches determining stiffness matricies "K" and "NLK" (see p.1415, Equations 7-9, and associated text), a residual vector (see p.1416, Equation 15, and associated text), and a Jacobian matrix "J" (see p.1416, Equation 23 and associated text), for the purpose of modeling vibrations of beams and plates.

20. The article by P. Rao, "An Efficient Scalable Finite Element Model for Simulating Large Scale Hydrodynamic Flows" teaches determining a stiffness matrix "K", a residual vector "R", and a Jacobian matrix "J", for the purpose of modeling hydrodynamic flows.

21. The only commonality between these different uses (modeling electromagnetics, modeling physical vibrations, and modeling hydrodynamic flows) is the underlying mathematics (which include the use of a "stiffness matrix" and a "residual matrix").

22. Applicants claims are directed exclusively to the mathematics, and lack any recitation of specific and substantial practical application. Examiner therefore has

determined that the claims attempt to patent every "substantial practical application" of an idea – a mathematical algorithm. Thus, the claims are non-statutory.

Claim Rejections - 35 USC § 102

23. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

24. The prior art used for these rejections is as follows:

25. Saitz, J. "Newton-Raphson Method and Fixed-Point Technique in Finite Element Computation of Magnetic Field Problems in Media with Hysteresis", IEEE Transactions on Magnetics, May 1999. Vol.35, No.3, pp.1398-1401. (Hereinafter "**Saitz**").

26. The claim rejections are hereby summarized for Applicant's convenience. The detailed rejections follow.

27. Claims 1-117 are rejected under 35 U.S.C. 102(b) as being anticipated by Saitz.

28. In regards to Claim 1, Saitz teaches the following limitations:

> *1. (Currently Amended) A method for determining at least one of a stiffness matrix and a residual vector for one or more systems, the method comprising:*
>
> *receiving a selection of one or more systems;*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

> *determining for the selected one or more systems at least one of the stiffness matrix by determining at least one of a Jacobian of a variable and a value of a variable in accordance with a type of the variable, the stiffness matrix being a Jacobian matrix of a residual vector with respect to a number of degrees of freedom, the Jacobian of a variable being represented as at least one contribution determined in accordance with a number of degrees of freedom and determining the residual vector by determining at least one of a Jacobian of a variable and a value of a variable in accordance with a type of the variable; and*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

> *providing the determined at least one of the stiffness matrix and the residual vector for the selected one or more systems.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

29. In regards to Claim 2, Saitz teaches the following limitations:

> *2. (Original) The method of Claim 1 wherein said non-local variable defines a value from a first domain in a first geometry to another domain in a second geometry.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

30. In regards to Claim 3, Saitz teaches the following limitations:

> *3. (Original) The method of Claim 2, further comprising: forming, for each of said first and second geometries, a system of partial differential equations each having associated coupling variables.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

31. In regards to Claim 4, Saitz teaches the following limitations:

> *4. (Original) The method of Claim 2, wherein at least one of said partial differential equation systems uses at least one local coupling.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

32. In regards to Claim 5, Saitz teaches the following limitations:

> *5. (Original) The method of Claim 2, wherein said first and second geometries are the same.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

33. In regards to Claim 6, Saitz teaches the following limitations:

> *6. (Original) The method of Claim 2, wherein said first and second geometries are different.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

34. In regards to Claim 7, Saitz teaches the following limitations:

> *7. (Original) The method of Claim 1, further comprising:*
> *defining a non-local coupling wherein a value of a quantity on a boundary of a first domain is referenced on parallel lines extending into said first domain.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

35. In regards to Claim 8, Saitz teaches the following limitations:

8. (Original) The method of Claim 2, further comprising: defining a non-local coupling in which a boundary condition associated with said first domain is defined using a value of an integral over a portion of one of: said first domain and said second domain.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

36. In regards to Claim 9, Saitz teaches the following limitations:

9. (Original) The method of Claim 1, further comprising: defining a non-local coupling using at least one of: a mapped variable and an integrated variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

37. In regards to Claim 10, Saitz teaches the following limitations:

10. (Original) The method of Claim 4, further comprising: defining a local coupling using at least one of: a basic variable, an auxiliary variable, and a glued variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

38. In regards to Claim 11, Saitz teaches the following limitations:

11. (Original) The method of Claim 1, further comprising: defining a non-local coupling variable using at least one of an extrusion variable, a projection variable, and a scalar coupling variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

39. In regards to Claim 12, Saitz teaches the following limitations:

12. (Currently Amended) The method of Claim 1, wherein the determining determines the stiffness matrix and wherein the providing

provides the determined stiffness matrix and the determined residual vector for the selected one or more systems.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

40. In regards to Claim 13, Saitz teaches the following limitations:

13. (Original) The method of Claim 12, further comprising: converting said combined system of partial differential equations from general form to weak form.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

41. In regards to Claim 14, Saitz teaches the following limitations:

14. (Original) The method of Claim 12, wherein said determining said stiffness matrix further comprises:
determining at least one of a Jacobian of a variable and a value of a variable in accordance with points included in a quadrature formula and with other points in accordance with coupling variables.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

42. In regards to Claim 15, Saitz teaches the following limitations:

15. (Original) The method of Claim 14, wherein said determining said residual vector further comprises:
determining at least one of a Jacobian of a variable and a value of a variable in accordance with points included in a quadrature formula and with other points in accordance with coupling variables.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

43. In regards to Claim 16, Saitz teaches the following limitations:

16. (Original) The method of Claim 1, further comprising: determining a value of a variable in accordance with a type of said variable used in at least one of said partial differential equation systems.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

44. In regards to Claim 17, Saitz teaches the following limitations:

17. (Original) The method of Claim 16, wherein variables are recursively evaluated in accordance with variable type.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

45. In regards to Claim 18, Saitz teaches the following limitations:

18. (Original) The method of Claim 17, wherein said determining a value of a variable in accordance with a type is used in determining at least one of a: stiffness matrix, constraint matrix, residual vector and a constraint residual vector.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

46. In regards to Claim 19, Saitz teaches the following limitations:

19. (Original) The method of Claim 18, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, and an integrated variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

47. In regards to Claim 20, Saitz teaches the following limitations:

20. (Original) The method of Claim 1, further comprising: determining a Jacobian of a variable in accordance with a type of said variable used in at least one of said partial differential equations wherein

said Jacobian of a variable is represented in accordance with a number of degrees of freedom.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

48. In regards to Claim 21, Saitz teaches the following limitations:

21. (Original) The method of Claim 20, wherein a Jacobian of a variable is recursively evaluated in accordance with variable type.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

49. In regards to Claim 22, Saitz teaches the following limitations:

22. (Original) The method of Claim 21, wherein said determining a Jacobian of a variable in accordance with a type is used in determining at least one of: a stiffness matrix, a residual vector, constraint residual vector, and a constraint matrix.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

50. In regards to Claim 23, Saitz teaches the following limitations:

23. (Original) The method of Claim 22, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, and an integrated variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

51. In regards to Claim 24, Saitz teaches the following limitations:

24. (Original) The method of Claim 1, wherein said at least one non-local coupling includes a variable having a dependency on another variable at at least one distant point.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

52. In regards to Claim 25, Saitz teaches the following limitations:

> *25. (Original) The method of Claim 24, wherein said other variable is in the same geometry as said variable.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

53. In regards to Claim 26, Saitz teaches the following limitations:

> *26. (Original) The method of Claim 24, wherein said other variable is in a different geometry from said variable.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

54. In regards to Claim 27, Saitz teaches the following limitations:

> *27. (Original) The method of Claim 4, wherein said local coupling includes a variable having a dependency only on values of other variables at the same point.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

55. In regards to Claim 28, Saitz teaches the following limitations:

> *28. (Original) The method of Claim 1, further comprising: defining a non-local coupling used in at least one of a: subdomain, boundary, edge, and point that obtains a value at one of: a subdomain, boundary, edge, and point.*

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

56. In regards to Claim 29, Saitz teaches the following limitations:

29. (Original) The method of Claim 4, further comprising: defining a local coupling using at least one of an expression variable and a boundary coupled variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

57. In regards to Claim 30, Saitz teaches the following limitations:

30. (Original) The method of Claim 1, further comprising: defining a non-local coupling wherein a value of an integral of a variable along parallel lines extending into a first domain is used on a boundary on said first domain.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

58. In regards to Claim 31, Saitz teaches the following limitations:

31. (Original) The method of Claim 1, further comprising: defining a boundary condition on one boundary in terms of a value of a variable on another boundary wherein said value is mapped in accordance with a coordinate transformation.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

59. In regards to Claim 32, Saitz teaches the following limitations:

32. (Original) The method of Claim 1, further comprising: defining a boundary condition in terms of a variable defined at a single point.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

60. In regards to Claim 33, Saitz teaches the following limitations:

33. (Currently Amended) A method <u>for determining at least one of a</u>

stiffness matrix and a residual vector for one or more systems, the method comprising:

receiving a selection of one or more systems:

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

determining for the selected one or more systems a stiffness matrix by evaluating at least one of a Jacobian of a variable and a value of a variable in accordance with a type of said the variable included in the one or more selected systems, the Jacobian of the variable being represented as at least one contribution in accordance with a number of degrees of freedom;

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

determining a residual vector for the selected one or more systems by evaluating at least one of a Jacobian of a variable and a value of a variable in accordance with a type of the variable included in the one or more selected systems, said Jacobian of said variable being represented as at least one contribution determined in accordance with a number of degrees of freedom; and

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

providing for the one or more selected systems the determined stiffness matrix and said determining a the determined residual vector.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

61. In regards to Claim 34, Saitz teaches the following limitations:

34. (Original) The method of Claim 33, wherein said system includes at least one non-local coupling and said method further includes evaluating at least one variable in said non-local coupling in at least one of: said

determining said stiffness matrix and said determining said residual vector.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

62. In regards to Claim 35, Saitz teaches the following limitations:

35. (Original) The method of Claim 33, wherein said system includes at least one local coupling and said method further includes evaluating at least one variable in said local coupling in at least one o£ said determining said stiffness matrix and said determining said residual vector.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

63. In regards to Claim 36, Saitz teaches the following limitations:

36. (Original) The method of Claim 33, further comprising: determining a constraint matrix by evaluating at least one of said Jacobian of a variable and a value of a variable in accordance with a type of said variable included in said system wherein said Jacobian of said variable is represented as at least one contribution in accordance with a number of degrees of freedom.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

64. In regards to Claim 37, Saitz teaches the following limitations:

37. (Original) The method of Claim 36, further comprising: determining a constraint residual vector by determining a value of at least one variable included in said system in accordance with a type of said at least one variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

65. In regards to Claim 38, Saitz teaches the following limitations:

38. (Original) The method of Claim 37, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, an integrated variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

66. In regards to Claim 39, Saitz teaches the following limitations:

39. (Original) The method of Claim 33, wherein said type is one of: a basic variable, an auxiliary variable, a glued variable, a mapped variable, an integrated variable.

(See Saitz, especially: "A. Newton-Raphson method (NRM)" on pp.1398-1399, and "B. Combination of Fixed-Point technique and Newton-Raphson method (FPT-NRM)" on p.1399)

67. **Claims 40-71 are rejected based on the same reasoning as claims 1-32. Claims 40-71 are computer readable medium claims that recite limitations equivalent to those recited in method claims 1-32 and taught throughout Saitz.**

68. **Claims 72-78 are rejected based on the same reasoning as claims 33-39. Claims 72-78 are computer readable medium claims that recite limitations equivalent to those recited in method claims 33-39 and taught throughout Saitz.**

69. **Claims 79-110 are rejected based on the same reasoning as claims 1-32. Claims 79-110 are system claims that recite limitations equivalent to those recited in method claims 1-32 and taught throughout Saitz.**

70. **Claims 111-117 are rejected based on the same reasoning as claims 33-39. Claims 111-117 are system claims that recite limitations equivalent to those recited in method claims 33-39 and taught throughout Saitz.**

Conclusion

71. The following prior art, made of record and not relied upon, is considered pertinent to applicant's disclosure.

72. Canova, A. and M. Repetto. "Integral Solution of Nonlinear Magnetostatic Field Problems", IEEE Transactions on Magnetics, May 2001. Vol.37, No.3, pp.1070-1077. (See especially the discussion of "degrees of freedom" on p.1070, left column, and the discussion of the Newton-Raphson algorithm on p.1073, left column).

73. Ribeiro, P. "Non-linear Forced Vibrations of Thin/Thick Beams and Plates by the Finite Element and Shooting Methods", Computers and Structures, May 2004. Vol.82, pp.1413-1423. (Intended use is discussed in the 101 rejections).

74. Rao, P. "An Efficient Scalable Finite Element Model for Simulating Large Scale Hydrodynamic Flows", 16th ASCE Enegineering Mechanics Conf., July 16-18, 2003. (Intended use is discussed in the 101 rejections).

75. 16th American Society of Civil Engineers (ASCE) Engineering Mechanics Conference, July 16-18, 2003. Printed 1/10/07. http://www.ce.washington.edu/em03/proceeedings/authorindex.htm. (Provides the date of the Rao Reference).

76. Persson, P. "Implementation of Finite Element-Based Navier-Stokes Solver 2.094 – Project". April 25, 2002. http://www.mit.edu/~persson/nsfem_report.pdf. (On p.4, teaches evaluating the tangent stiffness matrix in order to solve with Newton's method).

Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ayal I. Sharon whose telephone number is (571) 272-3714. The examiner can normally be reached on Monday through Thursday, and the first Friday of a bi-week, 8:30 am – 5:30 pm.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Tech Center 2100 Receptionist, whose telephone number is (571) 272-2100.

Ayal I. Sharon
Art Unit 2123
January 11, 2007

PAUL RODRIGUEZ
SUPERVISORY PATENT EXAMINER
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1/14/07